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of the sun and planets. Chapter II. gives a general description of the constellations and a discussion of the various star catalogues and charts since the time of Hipparchus. The next two chapters deal with stellar magnitudes, referring particularly to determinations of brightness made without instrumental means. The number and distribution of the stars, and a study of the Milky Way occupy two chapters.

The proper motion of the sun and the various methods of determining the apex of the sun's way are next considered, and this is naturally followed by the proper motions of the stars. An especially interesting table is that giving a comparison of the radial velocities with the proper motions on a great circle for fifty of the brightest stars. Chapter IX. treats of stellar parallaxes, giving the results obtained by many investigators. The volume closes with a chapter of 50 pages on variable stars.

The orbits of binary systems and the various methods of their calculation (Herschel, Kowalsky and Glasenapp, Zwiers) are discussed at considerable length, together with their number and dimensions, in the opening chapters of the second volume. A table is given containing the elements of sixty-six known orbits. The effect of the introduction of a linear element, the radial velocity, is treated in one of the sections, and M. André has calculated for the sixty-six well-established binaries the epochs at which a maximum radial velocity may be expected, and the value of that maximum on the assumption of a stellar parallax of $0''.2$. 'Astronomy of the Invisible' is the title of a chapter of 37 pages, dealing chiefly with the orbits of *Sirius*, *Procyon*, ζ *Canceri*, and 70 *Ophiuchi*.

The methods of Rambaut and Lehmann-Filhès for computing the orbits of spectroscopic binaries are given in sufficient detail in a separate chapter. About one hundred and thirty pages are next devoted to 'photometric binaries.' This includes a full historical account of *Algol* and its investigation by Pickering, Harting, Vogel, Chandler and Tisserand, together with all available data as to seventeen other variables of the *Algol* type. Dunér's beautiful work on the orbit of *Y Cygni*, pub-

lished last spring in the *Astrophysical Journal*, was unfortunately too late to be included.

Subsequent chapters treat of the clusters and nebulae, in particular of the *Pleiades*, *Præsepe*, and the region of η *Carinæ*; of the distribution of these objects, and of their distance. Globular clusters have a chapter of their own, which includes Bailey's recent remarkable variables. A short chapter is also given to colored stars.

The two volumes contain over one hundred cuts, and three excellent plates, and are printed in the usual excellent manner of Gauthier-Villars. A rather large list of errata is given, and probably more will be found. The book abounds in examples of the characteristic French disregard of the correct spelling and initials of foreign proper names.

This somewhat detailed account of the scope and contents of the work has been given to justify the remark that it fills a gap in the literature of the subject. The book would seem to be very well adapted for a basis of an elective course for seniors in our colleges, and the subjects treated are surely of greater freshness and interest, and of no less value in mental discipline, than the customary courses on the orbits of comets and planets.

A third volume is promised to complete the work—on the methods and instruments of modern research, and on the formation and evolution of the universe.

EDWIN B. FROST.

The Steam-engine Problem. By S. H. BARRACLEUGH, B.E. (Sydney), M.M.E. (Cornell). Russell School of Engineering, University of Sydney, N. S. W. Sydney, Kealy and Phillip. 8vo. 1900. Pp. 47. Figs. 13.

In this little book of less than fifty pages, Professor Barracleugh admirably outlines the problem of the steam-engine as it is now coming to be enunciated by scientific engineers and by thermodynamists who recognize the fact that the thermodynamics of the ideal may not constitute all, and that the real engine offers a complex problem which involves the most abstruse studies in physics, mechanics and energetics. This outline originally appeared in substance in the *Australian Technical Journal*. It was

written for students having an elementary knowledge of the subject.

The plan of the book includes a statement of the problem, its financial aspect, its mechanics, the scientific side and the practical side as well. The scope of the problem, choice of site, character of installation, type of engine and boiler, and their design, construction, erection and operation, are excellently stated, including the finance of the case. Finance is taken as the controlling factor, and the costs of steam-power are indicated and illustrated. Rankine's method of apportioning the engine to its work, as a financial proposition, is described, its fatal defect shown, and the later and corrected system of use of true 'curves of efficiency' is described. In designing, the method of Professor Barr of ascertaining the results of general experience in determining the factor of safety is described and its results given.

A brief and well-arranged statement of the fundamental principles of thermodynamics is presented and an excellent outline of the scientific side of the problem is laid down. The great defect of the real engine, its internal waste of heat and steam, is well described, as are the results of later investigations to determine its amount and its laws of variation.

R. H. THURSTON.

Catalogue of the Fossil Bryozoa in the Department of Geology, British Museum (Natural History). By J. W. GREGORY. The Cretaceous Bryozoa, Volume I. London, Longmans & Co. 8vo. Pp. 457. 17 pl.

The long list of British Museum (Natural History) catalogues has received another welcome addition in the Catalogue of the Cretaceous Bryozoa, Volume I., by Dr. J. W. Gregory. This catalogue is devoted entirely to descriptions and figures of the Cretaceous bryozoa, the groundwork, terminology, classification, etc., having been laid by the author in an earlier work of the same series: The Catalogue of the Jurassic Bryozoa in the British Museum (Natural History), published in 1896. In a second volume, to appear later, the author hopes to give a general introduction to the Cretaceous bryozoa, a list of localities with their horizons, and a bibliography. The catalogue is intended

to be complete, to include every recorded species, though the large number of inadequate descriptions by early writers and their unrecognizable figures will leave much in doubt. It is a question whether science would not be a gainer if much of this early work could be authoritatively set aside. The desire to conform too strictly to the law of priority or to do justice to early workers sometimes results in even greater injustice to later workers.

The present volume treats only of the Cyclostomata. This division Dr. Gregory raises to ordinal value and divides into the suborders: Tubulata, with the families Diastoporidæ, Idmoniidæ, Entalophoridæ, Eleidæ; Cancellata, with families Horneridæ, Petaloporidæ; Dactylethrata, with families Clausidæ, Terebellariidæ, Reticuliporidæ.

The large size of the present volume is itself evidence of the fine collection which the British Museum has accumulated. The author notes the large additions recently made to the collection and laments that an American collection was received too late to be included in this volume. Doubtless the second volume will supply the deficiency. No work of importance has been done on bryozoa from secondary and tertiary formations of America since the work of Gabb and Horn in 1860-62. The interesting bryozoan fauna of the Cretaceous marls of New Jersey has begun, however, to attract the attention of workers in this country as well as abroad.

The greatest of the many merits of the volume under consideration is the great care taken in collecting full synonymy and in giving careful, accurate descriptions with measurements. The rather complicated mode of relative measurements which the author employed in the volume on the Jurassic bryozoa he has abandoned for the simpler and more easily comprehended plan of absolute measurements. We believe the author adopts the correct position when he says that dimensions, while important, seem to him of far less value than is attached to them by some continental writers, who make them the chief specific distinctions. It is no doubt true that, in some groups, each species is very constant in its dimensions, while in other groups species are very variable in this respect. But the same is true of other charac-